

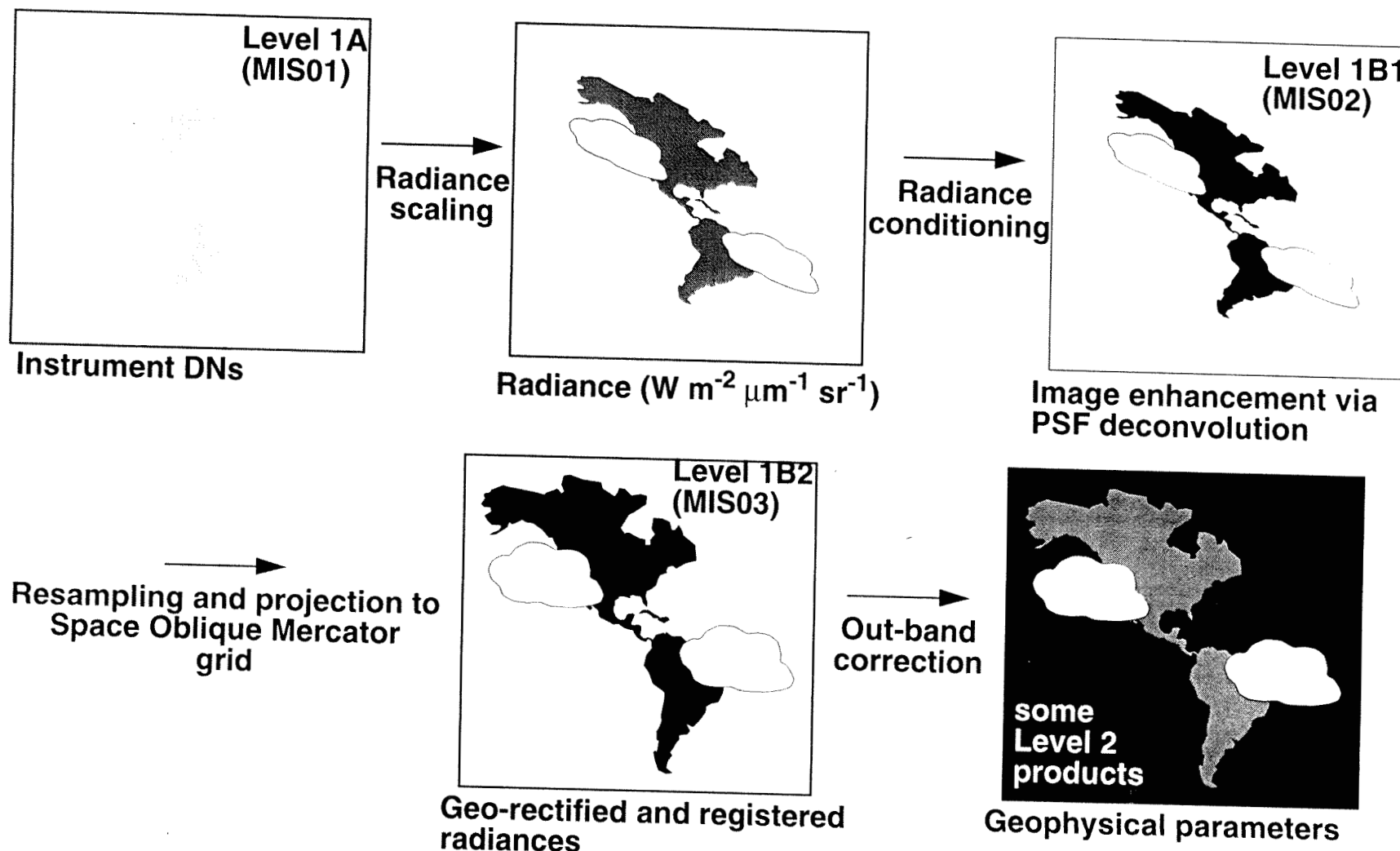
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# **MISR in-flight data processing system**

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Parameter name	Units	Horizontal Sampling (Coverage)	Comments
Radiance	$\text{W m}^{-2} \mu\text{m}^{-1} \text{sr}^{-1}$	250 m nadir, 275 m off-nadir, or averages per the camera configuration (Global)	<ul style="list-style-type: none"><li>• Radiometrically-scaled data</li><li>• No geometric resampling</li><li>• 9 cameras, 4 bands</li><li>• Uncertainty reported in Ancillary Radiometric Product</li></ul>
Data Qual. Indicator	None	Same as above	<ul style="list-style-type: none"><li>• 0 (within spec.); 1 (reduced accuracy), 2 (unusable for science); 3(unusable)</li></ul>

## **RADIANCE SCALING**

- Radiometric calibration coefficients are used to retrieve a band-averaged spectral radiance. Total-band response is included.

## **RADIANCE CONDITIONING**

- PSF deconvolution to sharpen the image, compensating for focal-plane scattering;
- A standardized spectral response function is assumed.

- Data Quality Indicators (DQI) are assigned to each Level 1B pixel. These are assigned the values:

DQI value	significance	Error component radiance uncertainty contribution	Level 1B2 resample weighting
0	within specification	None	full
1	reduced accuracy	1-3%	half
2	unusable for science	3-50%	none
3	unusable	>50%	none

- **Saturation blooming (Note: in average mode pixel is sat. if sat. in red band)**
  - DQI=0 if no. saturated pixels (nsat)=0
  - else DQI=1 if specific pixel under test has < 0.5% radiometric error
  - else DQI=1 if specific pixel under test has < 3.0% radiometric error; else DQI =2
- **Video offset uncertainty**
  - DQI=0 if line average DN less than threshold (~12,000 DN)
  - else DQI=1 if specific pixel under test has < 0.5% radiometric error
  - else DQI=1 if specific pixel under test has < 0.5% radiometric error; else DQI=2

- **Detector anomaly**

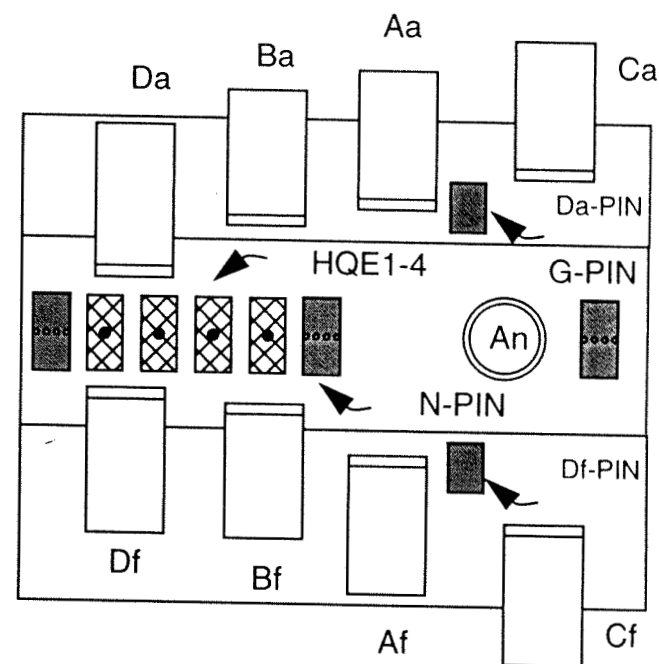
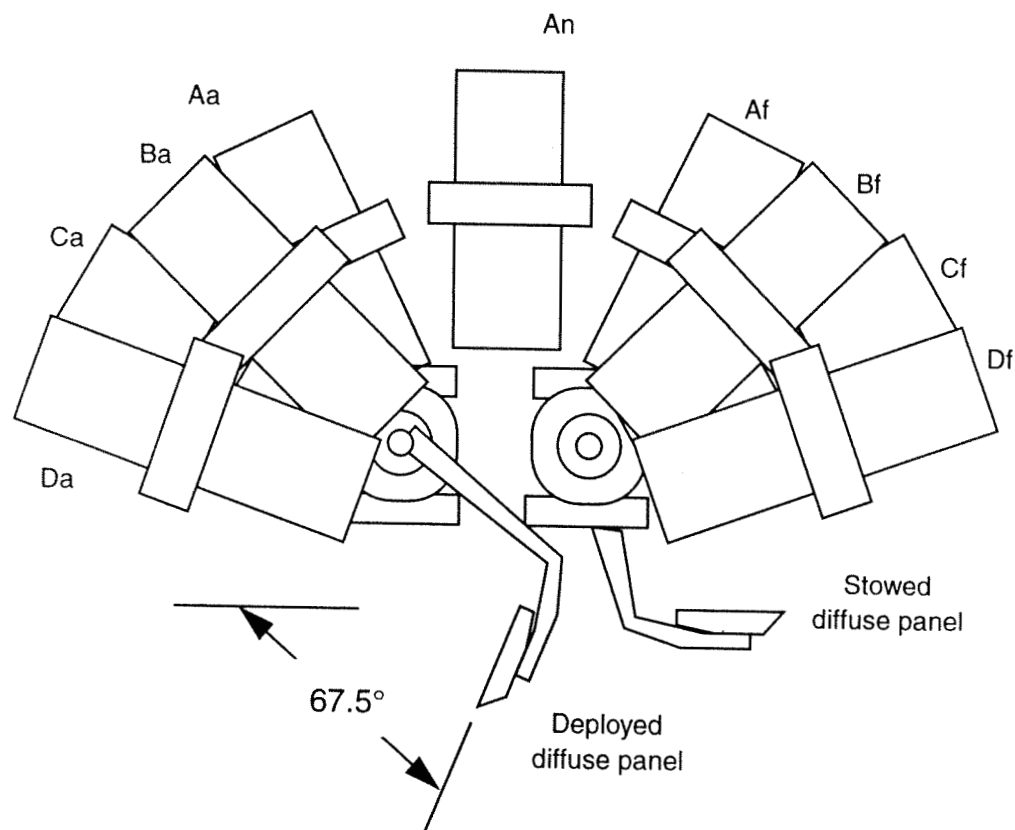
- Values can be predetermined and stored in ARP
- SNR used as DQI criteria

SNR	DDQI value
>100	0, else
>90	1, else
> 10	2, else
	3

- Detector response uniformity used as DQI criteria

Uniformity, 4x4 average mode	DDQI value
<10%	0, else
<15%	1, else
<50%	2, else
	3

Uniformity, 2x2 average mode	DDQI value
<10%	0, else
<15%	1, else
<50%	2, else
	3



**On-Board Calibrator (OBC)**

- **High quantum efficiency (HQE) diodes**
  - Detector-based radiometric standard for the instrument
  - Configured in light-trap arrangement to give near 100% QE
- **Radiation resistant PIN diodes**
  - Secondary detector standard (longer lifetime than the HQEs)
- **Deployable Spectralon diffuse panels**
  - Relative BRF needed to transfer diode measurements into camera view angles
  - Absolute reflectance knowledge unnecessary (slow degradation permissible)
- **Mechanized goniometer diode (G-PIN)**
  - Verifies BRF stability of diffuse panels

**Radiometric calibration**

- Acquire monthly OBC data (6 minute interval at each pole)
- Conduct semi-annual overflight field campaigns
- Calibration coefficients computed from a time trend analysis considering the preflight, OBC, and overflight measurements

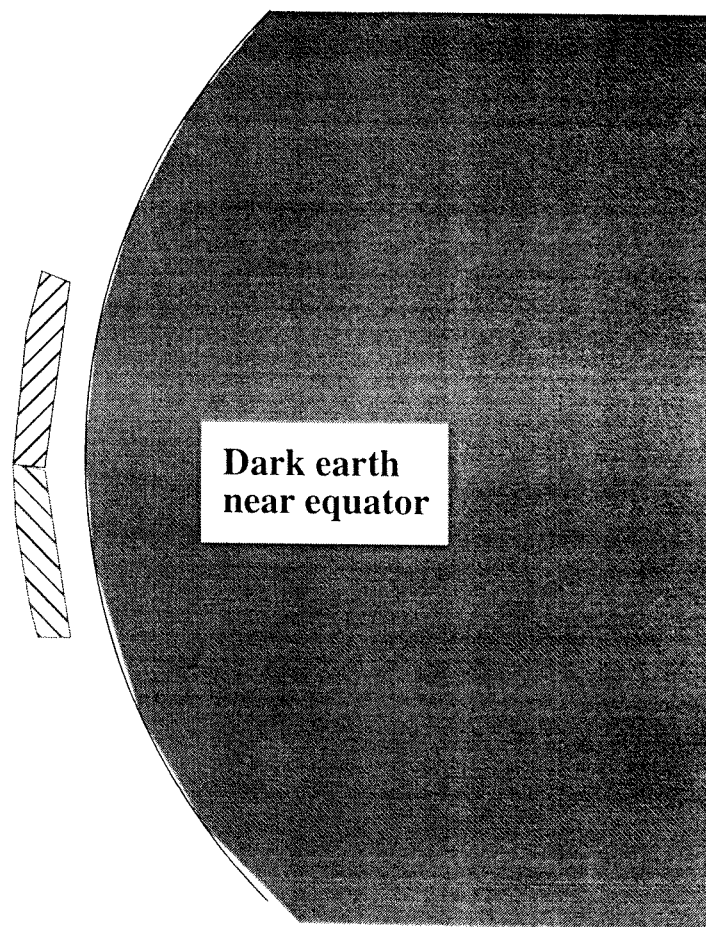
- **During calibration the instrument will acquire data at three positions within the orbit**
  1. CAL-DARK. Data are acquired over an ocean site (minimizing city lights) under minimal lunar illumination (new moon). These data provide the detector dark currents for every pixel of every camera. Dark current is expected to change slowly during the mission (monthly monitoring sufficient).
  2. During CAL-NORTH the nadir and aft-viewing cameras are calibrated with data acquired while viewing the +x diffuse panel.
  3. During CAL-SOUTH the nadir and fore-viewing cameras are calibrated with data acquired while viewing the -x diffuse panel.
- **During calibration data are taken using many camera configurations**

Configuration sequence	Comments
Integration Time Ramp	<ul style="list-style-type: none"><li>• Provides linearity information</li><li>• Data acquired at all allowable integration times</li><li>• Restore to mission integration time once complete</li></ul>
Averaging Mode	<ul style="list-style-type: none"><li>• Provides data in all data averaging modes</li></ul>
1x1	<ul style="list-style-type: none"><li>• Provides data with no on-board pixel averaging.</li></ul>
Accelerated Local Mode	<ul style="list-style-type: none"><li>• global mode with 1x1 cycling through 9 cameras</li><li>• provides data in science camera configuration</li></ul>

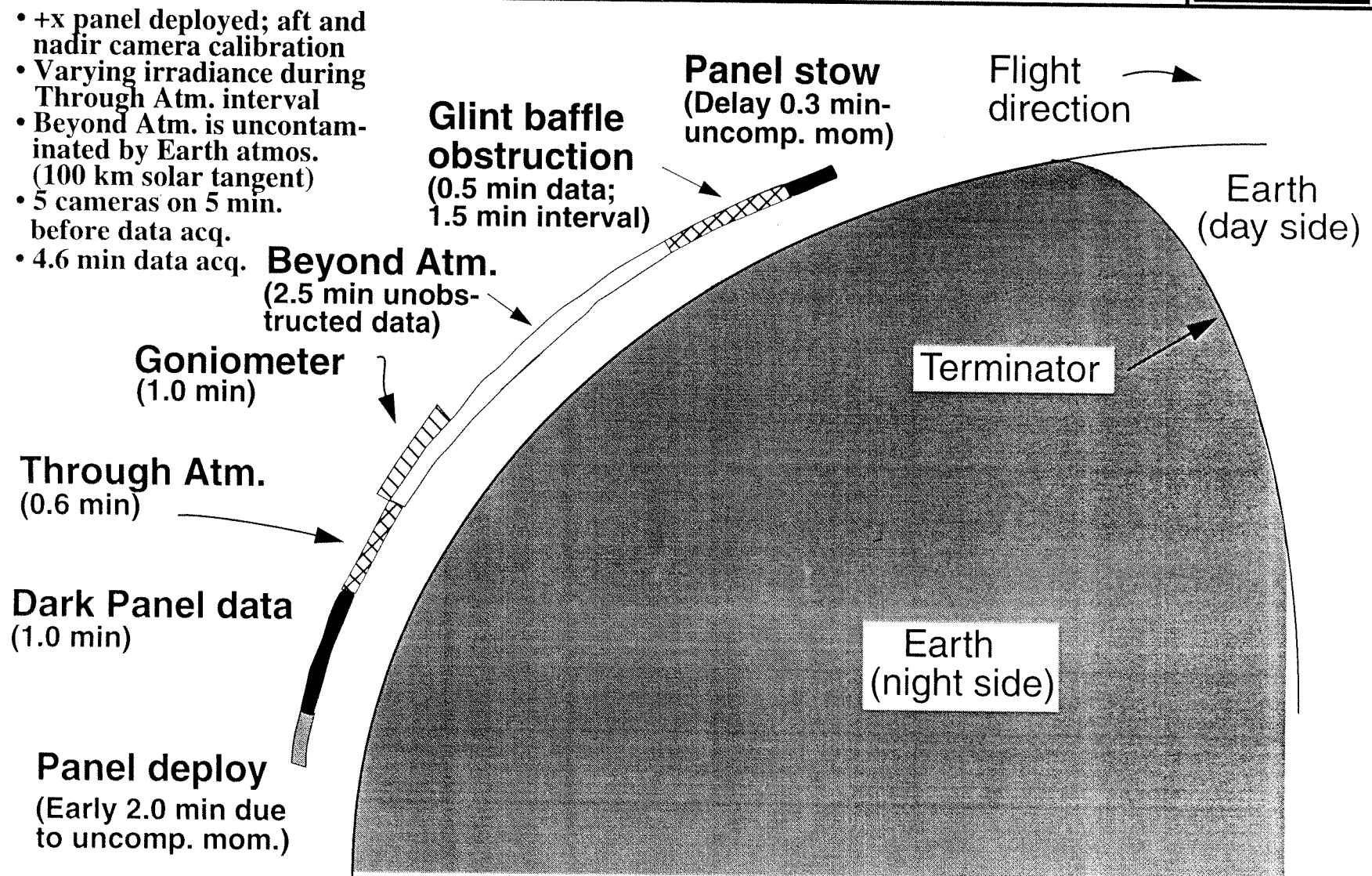
- Panels stowed
- New moon, dark ocean
- 9 cameras on 5 min. before data acq.
- 3.0min data acq.

**Aft+nadir camera  
data acquisition**  
(1.5 min)

**Fore+nadir camera  
data acquisition**  
(1.5 min)



- +x panel deployed; aft and nadir camera calibration
- Varying irradiance during Through Atm. interval
- Beyond Atm. is uncontaminated by Earth atmos. (100 km solar tangent)
- 5 cameras on 5 min. before data acq.
- 4.6 min data acq.



- MISR will be calibrated in-flight by a regression of incident radiance against output DN.
  - MISR will use a quadratic calibration equation

$$DN - DN_o = G_o + G_1 \mathcal{L}_\lambda + G_2 \mathcal{L}_\lambda^2$$

- $\mathcal{L}_\lambda$  is the sensor band-averaged spectral incident radiance, averaged over both in-and-out-of-band wavelengths and reported in units of  $[W\ m^{-2}\ sr^{-1}\ \mu m^{-1}]$ :

$$\mathcal{L}_\lambda = \frac{\int L_{source} \mathcal{R} \lambda d\lambda}{\int \mathcal{R} \lambda d\lambda}$$

- $\mathcal{R}$  is the relative pixel spectral response; DN is the camera output digital number;  $G_0$ ,  $G_1$ , and  $G_2$  are the pixel response coefficients;  $DN_o$  is the DN offset, unique for each line of data, as determined by an average over the first eight "overclock" pixel elements.

# IN-FLIGHT CALIBRATION UNCERTAINTIES

Ref no.	Parameter	Uncertainties, $\pm\%$		
		Using HQEs	Using PINs	Verification: check w/o diodes
1	HQE accuracy (design goal)	1.0	N/A	N/A
2	PIN accuracy (design goal)	N/A	3.0	N/A
3	$E_o * \rho$ knowledge	N/A	N/A	4.0 (predict)
4	Undetected spectral shifts	0.5	0.5	
5	Glint (variations in stray light on panel)	0.3	0.3	0.3
6	Stray-light bias (uniform stray light)	N/A	N/A	3.0 (goal)
7	Panel spatial non-uniformity	0.5	0.5	0.5
8	Relative BRF knowledge	0.5	0.5	N/A
9	Panel polarization	0.01	0.01	N/A
10	Transfer to $\rho=1.0$	0.1	0.1	0.1
	RSS total (design goal)	1.4	3.1	5.06

- **A processing system has been built to automatically ingest MISR flight data.**
  - Camera CCD are collected in all operating modes of the instrument
  - Radiometric calibration, signal-to-noise, pixel-to-pixel response variations, and analog-to-digital gain are measured with these flight data
- **Radiometric calibration is performed monthly**
  - Camera data acquired in unaveraged mode (1x1) and camera nominal integration times are used
  - Photodiode data are used to assign the incident radiance
  - Gain coefficients are retrieved and submitted to the Distributed Active Archive Center (DAAC)